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PATENT ABSTRACTS OF JAPAN

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(21)Application number : 05-310079
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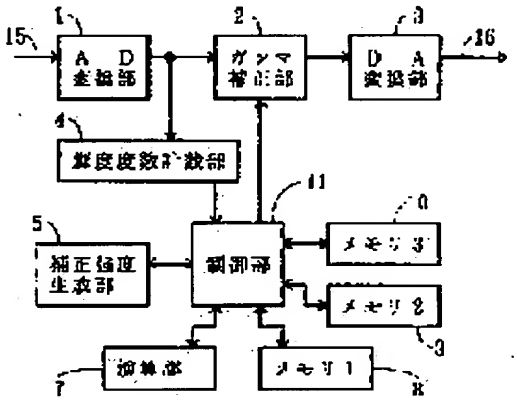
(71)Applicant : FUJITSU GENERAL LTD
(72)Inventor : EBISU NAOKI

(54) DIGITAL GAMMA CORRECTING METHOD

(57)Abstract:
PURPOSE: To optimize corrected lock-up data by introducing correction intensity based on the relation between a reference frequency value and a counted frequency.
CONSTITUTION: This method is composed of an AD conversion part 1 converting a supplied video signal 15, a gamma correction part 2 performing a gamma correction, a DA conversion part 3 converting digital data after a correction into a video signal 16, a luminance gradation frequency counting part 4 counting the data to be outputted by the AD conversion part 1 according to luminance gradation classes, a correction intensity generation part 5 generating correction intensity for every luminance gradation class based on the frequency counted for every luminance gradation class and a set reference value, an arithmetic part 7 generating correction lock-up data by introducing a function showing the relation of the correction intensity for every luminance gradation class, the histogram for every luminance gradation class of an original image and the histogram for every luminance gradation class after a conversion, a first memory 8 storing correction look-up data, a second memory 9 storing the frequency for every luminance gradation class, a third memory 10 storing correction intensity and a control part 11 controlling each part.



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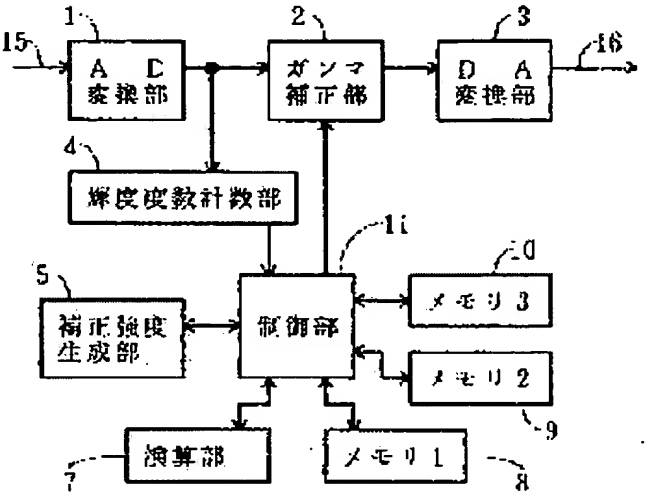
(71)出願人： 株式会社富士通ゼネラル
(72)発明者： 蝦子 直紀

(54) デジタルガンマ補正方法

(57)【要約】
【目的】度数基準値と計数した度数との関係に基づく補正強度を導入し、補正ルックアップデータの最適化を計る。
【構成】供給される映像信号15を変換するAD変換部1と、ガンマ補正を行うガンマ補正部2と、補正後のデジタルデータを映像信号16に変換するDA変換部3と、前記AD変換部1が出力するデータを輝度階調クラス別に計数する輝度階調度数計数部4と、輝度階調クラス毎に計数した度数と設定している基準値とに基づき輝度階調クラス毎に補正強度を生成する補正強度生成部5と、前記輝度階調クラス毎の補正強度と元の画像の輝度階調クラス毎のヒストグラムと変換後の輝度階調クラス毎のヒストグラムとの関係を示す関数を導入して補正ルックアップデータを生成する演算部7と、補正ルックアップデータを記憶する第一メモリ8と、輝度階調クラス毎の度数を記憶する第二メモリ9と、補正強度を記憶する第三メモリ10と、各部を制御する制御部11とでなる。



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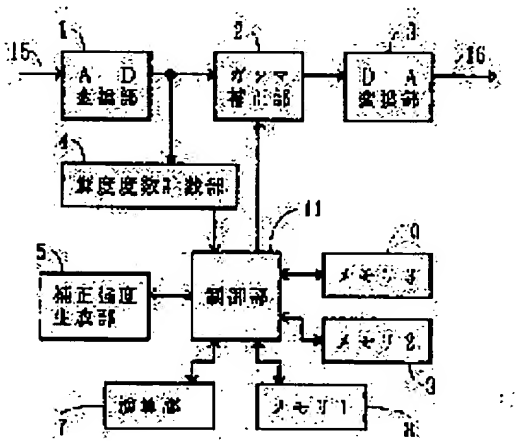
(57)Abstract:

PURPOSE: To optimize corrected lock-up data by introducing correction intensity based on the relation between a reference frequency value and a counted frequency.

CONSTITUTION: This method is composed of an AD conversion part 1 converting a supplied video signal 15, a gamma correction part 2 performing a gamma correction, a DA conversion part 3 converting digital data after a correction into a video signal 16, a luminance gradation frequency counting part 4 counting the data to be outputted by the AD conversion part 1 according to luminance gradation classes, a correction intensity generation part 5 generating correction intensity for every luminance gradation class based on the frequency counted for every luminance gradation class and a set reference value, an arithmetic part 7 generating correction lock-up data by introducing a function showing the relation of the correction intensity for every luminance gradation class, the histogram for every luminance gradation class of an original image and the histogram for every luminance gradation class after a conversion, a first memory 8 storing correction look-up data, a second memory 9 storing the frequency for every luminance gradation class, a third memory 10 storing correction intensity and a control part 11 controlling each part.



CLAIMS

[Claim(s)]
[Claim 1] The AD translation section which changes a video signal into digital data, and the gamma correction section which carries out the gamma correction of the digital data which holds the supplied gamma correction lookup data and the aforementioned AD translation section outputs based on these gamma correction data, the brightness frequency which carries out counting of the frequency for the digital data which the DA translation section which changes the digital data after an amendment into a video signal, and the aforementioned AD translation section output for every brightness gradation class -- counting -- with the section The corrected intensity generation section which generates the corrected intensity which shows the degree of a gamma correction for every brightness gradation class based on the frequency in which the aforementioned number section of brightness call meters carried out counting for every brightness gradation class, and the set-up reference value, The operation part which introduces the function which shows the relation between the corrected intensity for every aforementioned brightness gradation class, the histogram for every brightness gradation class of the original picture, and the histogram for every brightness gradation class after conversion, and generates gamma correction lookup data based on this function, The first memory which memorizes the said-generated gamma correction lookup data, The second memory which memorizes the frequency for every brightness gradation class in which the aforementioned number section of brightness call meters carried out counting, It becomes by the third memory which memorizes the aforementioned corrected intensity, and the control section which controls each part. The digital gamma correction method of improving the contrast ratio of a picture by carrying out flattening of the histogram for every brightness gradation class of the original picture with the gamma correction lookup data generated based on corrected intensity.
[Claim 2] the relation which it is unrelated to maximum when the value of the ratio of the frequency value and frequency reference value which carried out counting of the above-mentioned corrected intensity is 0, and serves as the minimum value at the time of 1 -- between the aforementioned maximum and the minimum values -- at least 1 -- the digital gamma correction method according to claim 1 set up so that this corrected intensity value might exist
[Claim 3] The function expression showing the relation between the histogram for every brightness gradation class of the picture of the agency describing above, and the histogram for every brightness gradation class after conversion The histogram value of the original picture of the brightness gradation class in which the histogram for every brightness gradation class after conversion ****s a corrected intensity value The molecule which comes to **, The digital gamma correction method according to claim 1 which constitutes the term which corrected-intensity-value-**(ed) the histogram value of the original picture of the brightness gradation class which said-****s from a denominator which it comes to add altogether for every brightness gradation class.
[Claim 4] The digital gamma correction method according to claim 1 characterized by preparing the gamma correction lookup data based on the corrected intensity of this plurality when the above-mentioned corrected intensity has values other than one and two or more these corrected intensity exists simultaneously.
[Claim 5] The digital gamma correction method according to claim 1 characterized by constituting the above-mentioned gamma correction section from SRAM.
[Claim 6] The digital gamma correction method according to claim 1 which prepares a counter and constitutes the above-mentioned number section of brightness call meters for every gradation class.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the technology which raises the contrast ratio of the picture to display by carrying out flattening of the gradation distribution state of a picture in detail with respect to the digital gamma correction method applied to liquid crystal projector equipment etc.
[0002]
[Description of the Prior Art] From the first, a gamma correction is an amendment currently performed by the sending area of a television signal because of an amendment of the luminescence brightness of Braun-tube formula television. It is not linear and the input voltage E of the Braun tube and the relation with the luminescence brightness L are L=Kx (gamma ** of E)... It can approximate with the relational expression of ** formula of which ** above is done. If L and E are plotted by both logarithmic scales, a straight line will be obtained and gamma will become the inclination. gamma is set to 2.2 in the color picture tube. Therefore, in order to make the gradation of a television screen, and a chromaticity reproduce in proportion to it of a photographic subject, it is necessary to rectify, and in order to mitigate the burden by the side of televising, an amendment of gamma=1/2.2 is applied by the sending area, and it is made for the display of the Braun tube to be gamma= 1 as a result in an NTSC color TV system. Since the input voltage of liquid crystal projector equipment and the relation of luminescence brightness differed from it of the Braun tube, they needed to perform the proper amendment by the liquid crystal projector equipment side. It may be carried out to a liquid crystal projector equipment side by doubling an amendment of profile emphasis etc. so that the above-mentioned gradation and not only the fundamental content of an amendment that reproduces a chromaticity correctly but a display image may become a legible picture. Especially the thing for which a contrast ratio is raised was the important technology for displaying the so-called legible picture. The gamma correction method which raises the contrast ratio currently carried out with conventional liquid crystal projector equipment is realized by the method of carrying out flattening of the gradation class frequency distribution. For example, if all brightness gradation is expressed for the gradation histogram 2 (b) of a picture in 256 stages by 8 bits according to a gradation class as shown in drawing 2 and drawing 3 Every 64 gradation A (zero to 63 gradation), and B (64 to 127 gradation), It can divide into four class A-D of C (128 to 191 gradation), and D (192 to 255 gradation). The brightness of a picture is divided into the four aforementioned classes for every field, and frequency-distribution data are generated. The drawing 2 (b), The class which a necessary criteria frequency value (alpha) is compared with the frequency of each class, and the class which, as a result, exceeds the aforementioned reference value alpha sets a decision value to '1', and is under the aforementioned reference value alpha is the drawing 2 (c) which sets a decision value to '0'. And by not rectifying, when this decision value is '1', preparing the look-up table drawing 3 (b) equipped equipped with necessary input-output behavioral characteristics, and referring to this table so that it may rectify, when this decision value is '0', the property drawing 3 (b) of the original picture was changed, and the property drawing 3 (c) after the conversion by which flattening was carried out had been obtained. However, in the property of a of drawing, when shown in drawing 4 with the frequency of each class near a criteria frequency value, since it is less than a reference value alpha in the gradation class (192-255) D class of the most significant, a decision value is set to '0'. In the property of b of drawing, since a reference value alpha is exceeded in the gradation class D of the most significant, a decision value is set to '1'. Therefore, by the picture of frequency distribution shown in the example of drawing 4 , the decision value was changeable, consequently since the gamma correction table chosen each time changed, the frequency distribution after the conversion by which flattening was carried out changed, and the problem on which the display image finally rectified flickers had occurred.
[0003]
[Problem(s) to be Solved by the Invention] this invention was made in view of the above-mentioned trouble, and it aims at offering the digital gamma correction method that a contrast ratio is improvable, reducing a flicker of the picture generated by the conventional digital gamma correction.

[0004]
[Means for Solving the Problem] The AD translation section which changes a video signal into digital data in order to attain the above-mentioned purpose, The gamma correction section which carries out the gamma correction of the digital data which holds the supplied gamma correction lookup data and the aforementioned AD translation section outputs based on these gamma correction data, the brightness frequency which carries out counting of the frequency for the digital data which the DA translation section which changes the digital data after an amendment into a video signal, and the aforementioned AD translation section output for every brightness gradation class -- counting -- with the section The corrected intensity generation section which generates the corrected intensity which shows the degree of a gamma correction for every brightness gradation class based on the frequency in which the aforementioned number section of brightness call meters carried out counting for every brightness gradation class, and the set-up reference value, The operation part which introduces the function which shows the relation between the corrected intensity for every aforementioned brightness gradation class, the histogram for every brightness gradation class of the original picture, and the histogram for every brightness gradation class after conversion, and generates gamma correction lookup data based on this function, the first memory which memorizes the said-generated gamma correction lookup data, and the aforementioned brightness frequency -- counting -- the section becomes by the second memory which memorizes the frequency for every brightness gradation class which carried out counting, the third memory which memorizes the aforementioned corrected intensity, and the control section which controls each part
[0005]
[Function] Since it constituted as mentioned above, flattening of the histogram for every brightness gradation class of the original picture is rectified and carried out by the corrected intensity generated in the corrected intensity generation section. The method rectifies by making the grade (the amount of amendments) of an amendment increase according to the rate in which the frequency value which carried out and carried out counting of the little amendment to the histogram of the original picture separates from a reference value, when the frequency value which carried out counting is close to a reference value.
[0006]
[Example] Hereafter, the digital gamma correction method by this invention is explained in detail using drawing. Drawing 1 is the example of the block diagram which enforces the digital gamma correction method by this invention. As shown in drawing, 1 is the AD translation section which changes the video signal 15 supplied into 8-bit digital data. 2 is the gamma correction section which performs a gamma correction while memorizing gamma correction data in the form of a look-up table so that the content of the aforementioned data table may be updated by the sent data, for example, as consists of SRAM (Static Random Access Memory) and outputs the amendment data of the aforementioned table which considered the aforementioned digital data which is 8 bits as the address input, and has memorized it to the ****ing address which the aforementioned AD translation section 1 outputs. 3 is the DA translation section which changes the digital data after an amendment into a video signal 16. the brightness frequency which 4 carries out counting of the digital data which the aforementioned AD translation section 1 outputs according to a brightness gradation class, for example, is constituted by preparing a counter every four gradation class A-D -- counting -- it is the section 5 is the corrected intensity generation section which generates the corrected intensity which shows the degree of a gamma correction for every brightness gradation class based on the frequency in which the aforementioned number section 4 of brightness call meters carried out counting for every brightness gradation class, and the set-up reference value. 7 is operation part which introduces the function which shows the relation between the corrected intensity for every aforementioned brightness gradation class, the histogram for every brightness gradation class of the original picture, and the histogram for every brightness gradation class after conversion, and generates gamma correction lookup data based on this function. 8 is the first memory which memorizes the said-generated gamma correction lookup data. 9 is the second memory which memorizes the frequency for every brightness gradation class in which the aforementioned

number section 4 of brightness call meters carried out counting. 10 is the third memory which memorizes the aforementioned corrected intensity. 11 is a control section which controls each part. In addition, each memory of the first memory 8 to the third memory 10 is memory which consists of RAM (Random Access Memory).

[0007] Operation of the digital gamma correction method by this invention is explained referring to drawing 5 . the video signal 15 with which the AD translation section 1 was supplied -- every 1 field (1V) -- for example, 8 bits -- quantizing -- brightness frequency -- counting -- the section 4 operates so that the histogram drawing 5 (b) which has brightness frequency-distribution data which carried out counting of the frequency every four brightness classes, A (zero to 63 gradation), B (64 to 127 gradation), C (128 to 191 gradation), and D (192 to 255 gradation), may be obtained In addition, the brightness gradation frequency-distribution property of the original picture is shown in the drawing 5 (b). In the corrected intensity generation section 5, corrected intensity P is calculated by following formula ** from the frequency value beta which carried out counting to the frequency reference value alpha shown in the aforementioned histogram drawing 5 (b).

P=PS+(1-PS) x beta/alpha ... **, however PS are standard corrected intensity in case the frequency value beta is 0. Moreover, when the frequency value beta is 0, corrected intensity decreases and is carried out [not rectifying when the frequency value beta is in agreement with a reference value alpha (P= 1) (minimum), and] as corrected intensity considers as the maximum and the frequency value beta increases. The drawing 5 (c) does not rectify by the aforementioned brightness class A-C being corrected intensity P= 1. The corrected intensity of the brightness class D is P=p which can be found from the relation of the aforementioned ** formula. In operation part 7, gamma correction lookup data are calculated based on following formula **.

$$g(j) = \frac{f(j)^P}{\sum_{i=1}^{m} f(i)^P} \quad \cdots ③$$

但し、 $\sum_{i=1}^{m} f(i) = 1$

In the histogram of the picture after conversion, and f (i), the histogram of the original picture and P show the aforementioned corrected intensity, and m shows [g (j)] the number of brightness gradation classes. For example, in operation part 7, the gamma correction lookup data which have the input-output behavioral characteristics shown in the drawing 5 (d) are generated. The gamma correction lookup data generated by the aforementioned operation part 7 are sent to the gamma correction section 2, for example, are memorized by SRAM, and update a data table while they are memorized by the first memory 8. For example, the gamma correction section 2 was supplied from the AD translation section 1, it performs conversion by giving 8-bit digital data to the address of Above SRAM, and reading suitable data. For example, histogram [of the original picture shown in the drawing 5 (**)] f (i) is changed by the gamma correction lookup data of the aforementioned drawing 5 (**), and histogram [of the picture after the conversion which showed the drawing 5 (**) and by which flattening was carried out] g (i) is obtained. In addition, the angle a shown in the drawing 5 (**) is given by f(i)/g (i).

[0008] It is attached to the extended example which uses two or more corrected intensity, and corrected intensity explains below in two examples. In addition, the explanation which overlaps the case where said one corrected intensity is used is omitted. In the case of a brightness gradation frequency-distribution property as the original picture shows to the (b) of drawing 6 , the frequency of the brightness classes A and D is the drawing 6 (b) used as beta2 and beta1, respectively. Each corrected intensity P is P2 and P1, as it is calculated from the following ** formula and shown in the drawing 6 (c). In addition, PS' is taken as standard corrected intensity in case the number of corrected intensity is two. The gamma correction lookup data generated by operation part 7 are calculated by following formula ** and **, and are the property of the drawing 6 (d).

$$P = P_s' + (1 - P_s') \times \frac{\beta}{\alpha}$$

$$= P_s' + (1 - P_s') \times \frac{\sum_{i=1}^{n} \beta_i}{n \times \alpha} \quad \cdots ④$$

$$g(j) = \frac{f(j)^P}{\sum_{i=1}^{m} f(i)^P} \quad \cdots ⑤$$

但し、 $\sum_{i=1}^{m} f(i) = 1$

In the histogram after conversion, and f (i), the histogram of a former picture and P express corrected intensity, and, as for g (j), m expresses the number of brightness gradation classes. However, the angle a shown in the drawing 6 (**) is given by a=f(i)/g (i). with the gamma correction lookup data of the property of the drawing 6 (**), flattening of the histogram [of the original picture shown in the drawing 6 (**)] f (i) is carried out -- having -- it is set to histogram [of the picture after the conversion shown in the drawing 6 (**)] g (i)

[0009]

[Effect of the Invention] As explained above, this invention offers the digital gamma correction method that a contrast ratio is improvable, reducing a flicker of the picture generated by the conventional digital gamma correction. Therefore, it has a high contrast ratio and there is a merit which can realize the high-definition liquid crystal projector equipment which moreover flickers and does not produce a phenomenon.

[Translation done.]